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Nails, Spikes, Bolts, Rivets, Screws, &c.—S. Watkins, 5701. E. S. Sheward and J. Jones, 5724. A. J. Paterson, 5024.

Oiling or Lubricating, &c.—F. Engel (com.), 5841. J. B. Aannay, 5875. O. Scholzig (com.), 6001.

Oils, Fatty Matters, Grease.—C. D. Abel (com.), 5575. S. Mellor, 5604. J. and G. Robinson, 5741. L. A. Groth (com.), 5787. J. B. Hannay, 5875. P. G. Oster, 5932.

Opatical Instruments, Optical Illusions, &c.—A. J. Boult (com.), 5654. W. E. Hancock, 6065.

Ornamenting, &c.—A. M. Clark (com,), 5040. C. D. Abel (com.), 5659. C. L. H. Lammers, 5838. J. H. Johnson (com.), 5921. E. Truchot, 5999.

Ovens and Kilns.—J. Broadhurst, 5738.

OXIDATION, (Preventing) &c.—J. B. Hannay, 5902.

PACKING Pistons, &c.—A. M. Clark (com.), 5535.

PACKING Goods, &c —T. and G. Borwick, 5811.

PAINTS, Colours, Varnishes, &c.—C. Cheswright (com.), 5929.

PAPER Pasteboard, Papier Mache, Paper Hangings.—S. Wells, 5674. P. Jensen (com.), 5708. R. Brodie, 5721. J. A. Timmis, 5952. E. K. Dutton (com.), 6052. T. Routledge, 6061.

PEAT, Turf, &c.—L. H. Armour, 5810.

PENS, Penholders, Pencils, Pencil Cases, &c.—A. Osborn, 5558. G. K. Cooke, 5718. M. Kerner, 5533. G. E. Conste, 5758. W. H. Davis, 6052.

PHOTOMETERS.—S. P. Thompson and C. Starling, 6034.

PIPES, Tubes, and Syphons: Joining Pipes.—J. Hunt and T. E. Milton, 5520. A. M. Clark (com.), 5535. S. Walker, 5597. S. Goodby, 5665. J. and F. Chambers, 5697. D. J. Morgan, 5725. D. Drummond, 5834. W R. Lake (com.), J. Chapman, 6080.

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PRINTING and Transferring: Type and other Surfaces for Printing, Composing, and Distributing Type.—H. J. Haddon (com.), 5532. J. Smyth, 5593. J. Ashworth, 5603. H. J. Haddan (com.), 5907.

PROPELLING Carriages, &c.—E. Edwards (com.), 5540. R. Brownhill, 7983.

PROPELLING Ships, Propellers, Paddle-wheel, and Screws.—W. J. Sage, 5563. A. M. Clark (com.), 5771. J. B. Hannay, 5902. H. J. Haddan (com,), 5994. F. A. F. Engel (com.), 6079.

PUMPS, Pumping and Forcing Liquids, Pumping and Raising Water and other Liquids, Pumps, Pistons, and Packing.—W. H. Wood and G. Richmond, 5798 S. Collingwood, 5803. T. F. Stenson, 5911.

PURSES, &c.—F. Baker, 5979.

RAGS, &c.—C. Harrison, 6081.

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REAPING and Mowing. &c.—A. C. Bamlett, 5567. R. Davison and T. H. Hallard, 5675. G. W. Brown, 575[illegible].

REFRIGERATING and Freezing, Cooling Liquids, Making Ices, &c.—S. P. Wilding (com.), 5546. W. R. Lake (com.), 5761.

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ROADS, Paths, &c.—E. Hughes, 5581. E. Foot, 5756.

RODS and Bars.—T. Smith and J. Drewitt, 5982.

ROPES, &c.—C. M. E. Kortum, 5740. D. R. and G. Malcolm, 5753. E. A. Brydges (com.), 6010.

SAFES, &c.—W. R. Lake (com.), 5938.

SALT, &c.—S. Pitt (com.), 6057.

SCENTS and Perfumes, Scent Bottles, &c.—J. F. Homer, 5804.

SCREWS, Screw Drivers, &c.—T. Dixon, 6051.

SEWING, &c.—W. H. Beck (com.), 5521. M. Gandy, 5703. T. Murphie, 5776. T. J. Denne, 5840. A. M. Clark (com.), 5883. T. Chadwick and J. Sugden, 6025. J. H. Johnson (com.) 6048.

SHEARS, &c.—E. Nunan, 6082.

SHIPS and Boats, &c.—W. Beverley and G. A. McLaverty, 5571. J. D. Barker, 5679. P. Jensen (com.), 5673. C. Morris, 5846. J. H. Johnson (com.), 5923. R. C. Scott, 5949.

SHIPS' Boats (Lowering) &c.—E. J. Harland, G. W. Wolff, W. H. Wilson and W. J. Pirrie, 5775.

SHIPS' Cargoes.—G. Taylor, 5727.

SHOT, Shell, Bullets, Cartridges, Percussion Caps, &c.—M. Delmard, 5770. H. Simon (com.), 6026.

SIFTING, Sorting, and Separating, &c.—N. and L. Greening, 5993.

SIGNALS, &c.—W. Sharpe, 5663. W. L. Hunt (com.), 5693. R. W. Vining, 5800. J. Sansom, 5872. W. R. Sykes, 5950. J. Steven, and T. Burt, 6018.

SOUNDINGS, &c.—F. Sutcliffe, 5606.

STEAM and other Boilers, Cleaning and Preventing Incrustation of Boilers, Water Feeding Apparatus for Boilers.—A. J. Smith, 5621. C. D. Abel (com.), 5622. W. R. Lake (com.), 5832. A. M. Clark (com.), 5939.

TELEGRAPHS; Telegraph Printing Apparatus.—J. B. Spence and J. E. Chaster, 5625. H. H. Lake (com.), 5633. T. Torrey, 5702. W. L. Hunt, 5693. S. P. Thompson, 5742. W. R. Lake (com.), 5870. G. L. Anders and J. B. Henicke, 6020. W. R. Lake (com.), 6023. W. R. Lake (com.), 6085.

TENTS, &c.—H. E. Newton (com.), 5530.

THERMOMETERS, Barometers, Pyrometers, &c.—G. L. Winch, 5894.

THREADS and Yarns.—W. Trafford, 5589.

TICKETS, Labels, &c.—C. H. and C. W. Thompson, 5847.

TILLING and Cultivating, &c.—S. Pitt (com.), 5573. W. Fisken and S. Robson 5638. J. Howard and E. T. Bonsfield, 5687. H. J. Haddan (com.), 5728. J. Parker, 5792.

TOBACCO and Snuff, Cigars, Cigar-Holders, Pipe and Cigar-lighters, Smoking Pipes, Tobacco, Pouches, &c.—W. Sharman, 5773. A. Barr, 5908. O. W. T. Barnsdale, 5942.

TOYS, &c.—H. H. Lake (com.), 5634.

TRAMWAY CARRIAGES, &c.—E. Dyson, 5527. W. H. Hindle, 5568.

TRAMWAYS, &c.—W. Garnett, 5614. H. M. Smith (com.), 5690. E. C. Wickes and T. E. Beaumont, 5824. J. E. Walsh (com.), 5878.

TRAPS for Drains, &c.—T. Carder, 5636.

TUNNELS, &c.—H. N. Maynard and H. J. Cooke, 5928. C. G. Clarke and R. St. G. Moore, 5947.

UMBRELLAS.—J. Ford, 5784.

UPHOLSTERY, &c.—T. Kendrick, 5590. S. K. Ibbetson, 5793.

URINALS, &c.—F. Wirth (com.), 5542.

VALVES, Taps, Stop Cocks, Plugs; Regulating the Flow and Pressure of Fluids.—P. Yates, 5522. J. W. Jordan and J. T. Brocklis, 5534. C. Pilkington and J. Forrest, 5543. P. Gibbons and S. F. Robinson, 5732. I. Gooder, 5750. A. Haigh, 5883. W. Hargreaves and W. Inglis, 5969. C. W. Gauntlett, 5996. J. Williams, 6069.

VELOCIPEDES.—H. J. Hissett, 5599. J. Hix, 5629. M. D. Rucker and H. S. Jackson, 5722. W. R. Pidgeon, 5853. E. A. Tice, 5858. J. R. J. R. Trigwell, 5882. E. de Pass (com.), 5905. W. H. Thacker and J. T. Green, 5940. R. W. Brownhill, 5983. O. Pihlfeldt, 5991. C. Tomkins, 6032. E. Marshall, 6063.

VENTILATING, &c.—F. Binney, 5851. T. H. Thompson, 5876. J. White, 5892. J. C. Baker, 5920. C. Brothers, 5960.

VESSELS.—H. Vollmer (com.), 6073.

WALKING STICKS, &c.—J. T. Lord, 5784.

WASHING, Cleansing, and Wringing Fabrics, Yarns, and Materials.—H. J. Haddan (com.), 5995.

WATER-CLOSETS, &c.—R. Leash, 6049.

WATER-POWER Engines, &c.—E. Wimshurst, 6036.

WATERPROOFING, &c.—W. R. Lake (com.), 6066.

WEAVING, Braiding, Plaiting, Preparing for Weaving, &c.—J. R. Hutchinson, 5569. G. Keighley, 5608. J. Holt, 5630. J. F. Brown, 5668. P. J. G. Moroy, 5691. A. Smith, 5904. W. Adam, 5916. J. Irving, 5964. D. Eastwood 5974.

WEDGES, &c.—G. Guthrie, 5948.

*** *The above List is prepared from the Patent Records by Mr. T. Morgan, Secretary of the Inventors' Patentright Association, Limited.*

An improvement in *car couplings* has recently been patented by Mr. Charles E. Macarthy, of Forsyth, Ga. This invention relates to an improvement in automatic car couplings, designed principally to hold the ordinary link in horizontal position favourable for automatic coupling.

Reviews.

CONSTRUCTION OF FLUTES.

"An Essay on the Construction of Flutes, giving a History and Description of the most Recent Improvements, with an Explanation of the Principles of Acoustics Applicable to the Manufacture of Wind Instruments. Originally written in 1847 by THEOBALD BÖHM, of Munich, and now first published. Edited, with the addition of correspondence and other documents, by W. S. BROADWOOD. Rudall, Carte, and Co., 23, Berners Street, Oxford Street, London, W. 1882.

THIS work is one that affords an interesting view of an inventor's life and progress, although confined to musical instruments such as the flute, &c. Being, as we are, firmly impressed with the notion that the parties themselves can always tell their own tales better than others can repeat same for them, we now present the matter in the form of its prefatory observations, by Mr. Broadwood.

The pamphlet—now published for the first time, and giving an account of the various alterations and improvements made by Böhm in the flute—was written by him, in English, for Mr. Rudall, in 1847; probably with a view to explain the principles on which the Böhm Flute was constructed, and, also, to set forth the advantages of the particular (cylindro-conical) form of it, for which Messrs. Rudall and Rose were then taking out a patent.

Mr. Rudall, however, did not care to publish the treatise. It was laid aside, and forgotten until quite lately; when, soon after Böhm's death, certain public attacks upon his character, coupled with a denial of the originality of his invention, drew from me a reply. This reminded Mr. Carte, the present representative of the firm of Rudall and Rose, that he possessed Bohm's own account of all the circumstances in dispute, and he was good enough, Mr. Broadwood goes on to say, to send it to me; this pamphlet, which is in Bohm's own hand-writing, as I can vouch, has an interest of its own, wholly distinct from the facts relating to Bohm's connection with Gordon. I imagine it will be read with no little pleasure by most flute players, whether professional or amateur, giving us, as it does, a clear and succinct summary of those principles of acoustics which are applicable to the construction of all wind instruments.

I should suppose that the Bohm *versus* Gordon much-debated controversy would now, by impartial persons, be considered as settled—all the more that our much-injured "countryman" turns out to have been a Swiss. Yet determined partisans are not easily daunted, and we know that, though we

"Convince a man against his will,
He's of the same opinion still."

I had not seen Bohm's pamphlet when I replied to the accusation, that by stealing another man's invention, shown him in confidence, he had driven that man to despair, insanity, and suicide, while acquiring for himself unmerited distinction. I am glad to see that Bohm, both in this pamphlet and in his letters, has anticipated my defence almost literally. He says that the so-called Bohm fingering *was* invented by himself; and Gordon's acknowledgment, printed with his table of fingering, goes far to prove the assertion. And Bohm goes on to say that he never attached very much value to the fingering alone, but that his really important achievement was the successful substitution of acoustic theory for mere empirical experiment in the construction of several varieties of wind instruments." "For *this*," he says, "is the chief foundation of the higher or lower degree of perfection in all instruments, their mechanism being but of secondary importance. *It is also much* *easier to construct keys than to improve notes.*" I propose to reprint in an appendix my own article, originally, most courteously, published in the *London Figaro*, as well as in the *Musical World*; also the much more important paper written about the same time by Dr. Schafhaeutl, of Munich. These, with Bohm's own account, give at all events his side of the question as to the authenticity of the invention, which, however, in no degree affects the inherent interest of his English pamphlet.

In going through this latter, I have been careful to avoid all unnecessary interference with the original text. Bohm wrote and spoke English very fluently; and in ordinary conversation expressed himself very correctly. All who have taken the trouble to acquire a more than merely superficial acquaintance with foreign languages will know that it is one thing to converse and write on general and indifferent subjects; another, and a very different thing, to attain such a command of accurate and technical terms as may be necessary for even a popular explanation of scientific subjects. Your German, also, revels in parentheses; he loves to string them together like old bills on a file, until, having made up a sufficient bundle, he clinches the whole with the long suspended verb, and so finally reveals his meaning. We Britons cannot wait so long; we love to get direct to our object. To some of us possibly, the delay is not only irritating, but even confusing: and for this reason I have ventured to unravel certain phrases of Bohm's, which were much more akin to German than to English, and in the nature of a compromise between the two languages, my effort always being to express what I took to be his meaning in the fewest and most direct words. After all, these alterations do not amount to very much: and may almost be classed with the correction of "clerical errors."

I will include in the Appendix, extracts from Bohm's letters, of which I have kept a considerable number; because there is much in them of general interest; and a good deal which goes to show that Bohm was not the "ignorant impostor" I once heard him called by a gentleman whose claim to celebrity rested on the invention of a key, which Bohm (a plagiarist by anticipation) had already used for his oboe fingering some years before. The answers to various questions as to pitch, bore, position of holes. &c., which I have quoted, show beyond doubt, that Bohm understood his subject thoroughly; they also afford practical, and often very useful hints for the management of flutes, and the application to them of theory, as laid down in the pamphlet.

Bohm's flute was not only an improvement on the "old flute," but differed from it so materially in character and colouring of tone, that it has on this account been excluded from some of the Continental orchestras. In France it is generally used, but certain German conductors appear to have considered that the Bohm flute does not take its proper place in that gradation of "wood" instruments, which, commencing with the bassoon, culminates in the piccolo. In power and breadth of tone, sometimes also in quality, it approaches too near the clarinet to give the balance of tone, which writers—like, for instance, Mozart (whose minute appreciation of the characteristics of each instrument is very striking)—would seem to have aimed at. Of course very much depends on the individual artist, who may use, or may abuse, the increased power of his instrument. The silver Bohm flute, when used (as is now rarely the case) in the orchestra, stands out perhaps too distinctly from the other instruments. The tone will not blend. I have heard it from the further extremity of an exhibition building, apparently playing isolated phrases, without accompaniment; as I approached, the double basses became audible, then came the violins; but the silver flute was heard before them all. Its blowing, however, requires very peculiar management. Bohm constantly insists on this in his letters; and certainly his own tone was wholly free from all shrillness when he played on a metal flute. I think the same might formerly be said of Mr. Svendsen's tone when he used a silver flute. The contrary is more generally the case; but Mr. Svendsen is an admirable artist, and his tone is exceptionally good on the wooden flute also. In his pamphlet, Bohm alludes to the effect produced by players on the old flute; and in one of his letters he says that, but for Nicholson, he should never have attempted any radical change of system. He despaired of rivalling Nicholson's great power with anything but an improved instrument, and so set to work to devise one.

KINEMATICS.

"Uniplanar Kinematics, or, Solids and Fluids, with Applications to the Distributing and Flow of Electricity." By George M. Minchin, Professor of Applied Mathematics, Royal Indian Engineering College, Cooper's Hill. Oxford: At the Clarendon Press. 1882.

The title above stated fully designates the nature and object of this admirable work, which it would be useless labour to describe in other words than those of its preface.

The present work aims at supplying a deficiency in the course of Mathematical Physics usually pursued by the higher class students in our colleges and universities; where, in the majority of cases, little attention is paid to the special study of Kinematics, and, as a consequence, the student enters into the study of Kinetics with somewhat misty notions of *acceleration* and other leading conceptions which belong to the province of Kinematics.

In view of the great progress which has been made in this country in Experimental Physics, under the leadership of Faraday, Thomson, and Clerk Maxwell, it appears desirable to include in the ordinary course of higher mathematics as much as possible of the application of mathematics to physical problems—at the expense, no doubt, of its applications to manifest unrealities. A large portion of this work deals with the theory of fluid motion and electric distribution and flow, in accordance with these views.

Anything like a complete treatise on general (or three-dimensional) Kinematics would be a much more difficult task, and would be addressed to a very limited class of students. When, however, the leading results for motion in one plane are properly mastered, the student will have little difficulty in understanding what they become when a third co-ordinate is introduced. Thus much as to to the general aim of the work. The subjects treated of call for a few special remarks, as to which Mr. Minchin states:—

In Chapter I. considerable attention is devoted to the Instantaneous Centre (of velocities), and in Chapter II. much prominence is given to the Instantaneous Acceleration Centre, with the accompanying Centrodes, some results with regard to which will probably be new to most readers. Applications of these results are made to several problems, the solutions of which are thus simplified. Professor Wolstenholme kindly placed his "Book of Mathematical Problems" at my disposal, and I have freely availed myself of his permission to select illustrative questions.

Chapter III. deals largely with Roulettes, and aims at bringing under one general principle the discussion of many isolated results. Some of the theorems in this chapter are, I believe, new; and for several of them I am indebted to the kindness of Mr. McCay, Fellow of Trinity College, Dublin. My obligations are very great to such an elegant and skilful geometer for the assistance which he has rendered.

In Chapter IV. I have advocated a reversion to the use of the term *force of inertia* which was employed and clearly explained by Newton, and which is employed by many French physicists, including Delaunay. The term was shown by Newton to convey a definite physical idea, to which, it seems to me, greater prominence ought to attach, now that the notion of actions propagated through a medium has been brought into such importance by the experiments of Faraday and the great work of Clerk Maxwell. The expression "effective force," used by D'Alembert, seems but a poor substitute for Newton's *vis inertiæ*.

Chapter V. follows closely the order and method of the chapter on three-dimensional strain in my "Statics."

Chapter VI. contains the subjects which, undoubtedly, are the most difficult of treatment in the book; and I could not venture, with any degree of confidence, to publish it without the criticism of some able physicist. Happily, Professor O. J. Lodge and his brother, Mr. Alfred Lodge, Fereday Fellow of St. John's College, Oxford, rendered their invaluable aid, and many alterations and improvements in the original M.S. of the chapter are the result of their criticism.

The student, it is hoped, will find, in particular, the section on Conjugate Functions an assistance in his reading of Clerk Maxwell.

Lamb's admirably simple "Treatise on the Motion of Fluids" has been of much assistance to me in this chapter, and I must thank my friend Professor G. Carey Foster for the free use of his papers on "Electrical Flow," and his revision of the pages dealing with this subject.

Some notes treating more generally of kinematical questions are added, in the belief that they will be of assistance to the more advanced student. I may particularly mention Note D, on "Vectors and their Derivatives."

Professor Minchin concludes by saying, Captain Eagles has rendered me efficient service in revising the proofs, and I hereby acknowledge my obligations to him.

We cannot present our readers with Kinematic quotations, want of space prohibiting; we therefore only refer them back to our opening statement in favour of the work

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Mr. James Maller, of Wellsville, O., has patented an improved *pulley* for driving light machinery. A pulley made in skeleton form is keyed to the shaft, and a loose pulley consisting of a tire like band surrounds it and revolves in the same plane. On the inside of the band are notches that are right angled on one side and inclined on the other, into which radial arms are forced by means of levers, and a sliding collar on the shaft to attach it to the fixed pulleys. Lateral displacement is prevented by lugs on the fast pulley.

An apparatus to prevent the accumulation of scale or *sediment in boilers* has been patented by Mr. William Ord, of Brooklyn, O. A brush of steel or other suitable material, shaped to conform to the interior surface of the boiler is hung in the boiler on the ends of two wires that pass to the outside through opposite ends of the boiler, and connected to rollers, by which the brush is drawn backwards and forwards on the inner surface, to loosen the sediment and carry it to the mud drum. A heel attached to one side of the brush prevents its working when it is drawn to the front.

Mr. Charles J. Gibson, of Bergen Point, N.J., has patented an improvement in that class of *lawn-mowers* having spirally arranged cutters revolving about a horizontal axis. This machine possesses several points of novelty, which increase its effectiveness and durability.

STAR MOTIONS.

On beholding the stellar heavens, two remarkable features strike the eye of the ordinary observer: first, the irregular distribution of the stars; and second, their varying brightness. In the earliest times stars were recognised by their superior lustre, and from their positions in certain groups, called constellations. The ancients ascertained further, that with respect to a limited number of the stars, their places in the heavens, relatively to the great groupings or constellations, were constantly changing. These were called Planets, or wandering stars; while the general mass, in consequence of their appearing to maintain the same relative position, were, and are, to this day, spoken of as fixed stars.

At the present epoch of the world's history, it seems a very easy thing to mentally realise that if our own sun were removed to a much greater distance from us, he would decrease in size as he receded, until, in appearance, we could not distinguish him from one of these so-called fixed stars.

Yet simple as this may seem, it took the human race all the time from Ptolemy to Huyghens to grasp the idea that the supposed fixed stars are suns.

We now know that fixity is nowhere to be found in nature, and that even the face of the heavens is undergoing changes which, however slight they may appear to us, are of the most stupendous description.

To Halley must be ascribed the honour of having first shewn that some of the stars have a proper motion of their own. In 1717 he communicated a paper to the Royal Society, in which he showed that by comparing the places of Sirius, Aldebaran, and Arcturus, as observed by himself, with the same as determined about 130 B.C., by Hipparchus, these same stars had sensibly moved southward with respect to the ecliptic; and that this was further confirmed by an account of an occultation of Aldebaran by the moon, observed in the year 509 A.D., at Athens. The next great worker in this field of observation was Bradley. In fact, the series of splendid observations made by this famous astronomer has formed the basis of the extensive investigations of modern times relating to this subject. The twelve years work of Bradley, from 1750 to 1762, was utilised by Bessel, the German astronomer, and the results were published in the year 1818. Our own late Astronomer-Royal, Sir George Airy, continued the great work, which, along with the observations of some other astronomers, has resulted in an amount of knowledge on this subject, which at one time would have seemed utterly impossible to attain.

The following table shows the amount of proper motions of a number of stars, which have been determined with great care and relative exactitude:—

Star.	Magnitude.	Proper Motion in a Thousand Years. Seconds.
Sirius	... 1 ...	1,360
Procyon	... 1 ...	1,210
Arcturus...	... 1 ...	2,230
α Centauri	... 1 ...	3,710
Capella	... 1 ...	250
Rigel	... 1 ...	20
Antares	... 1 ...	30
Groombridge 1830 ...	.. 7 ...	7,106
61 Cygni	... 6 ...	3,200
O^2 Eridani	... 4 ...	4,100
Lalande, 27,744	... 6 ...	1,681
Lalande, 30,044	... 7 ...	1,607
Lalande, 30,694	... 6 ...	1,789
Weisse's Bessel XVII., 322	... 7 ...	1,476

The last four of these have only recently been detected at the Glasgow Observatory, where a careful system of star-observation has been prosecuted since the year 1860.

It is clear from the foregoing table that the proper motion of a star has no relation whatever to its magnitude, as apparent to us, on this planet. As, for instance, Rigel, one of the most magnificent stars in the heavens, has an apparent motion of only 20 seconds in a thousand years. Whereas 1830 Groombridge, a star of the seventh magnitude, has a motion of 7106 seconds in the same time.

At first sight it would appear to us most natural to expect that the larger stars, which we presume to be the nearest, would exhibit the greatest amount of apparent motion; but this is clearly not necessarily so. It is true that in the cases of Alpha Centauri, and 61 of the Swan, which, from the researches of our astronomers, we now know to be two of the nearest stars to our solar system, a large apparent motion accompanies comparative proximity; but the very opposite holds good with Groombridge 1830. The explanation of these apparent anomalies lies in the *direction* of the motions of the stars, as it is clear we cannot observe any motion other than such as are resolved at right angles to the line of sight. Motions of approach and recession relative to our vision making no impression other than so slight an increase or decrease in brilliancy, as to be utterly inappreciable by the human eye alone. It thus follows that if the stars, as suns, are following an elliptical orbit approximating even to the circular, that at two portions of such orbit, the right angular displacement, as seen by us, will be very small indeed. It is, however, within the bounds of possibility that some suns have orbits of eccentricity approaching to the parabola; in which case such a star would have a far greater apparent motion if viewed in the line of the minor axis of its ellipse, and might appear to stand almost still for ages if viewed along the major one. And as we may expect both the axes and the planes of the orbits of the stars to lie at many varying angles with our line of sight, so will the resultant apparent motions vary, without respect to either distance, size, or intrinsic brilliancy of any particular sun.

So far as observation has yet gone, the proper motion of each star has been found to be constantly in one direction, which tends to prove that a single passage of any star along the whole length of its path occupies ages and ages of time, as we are compelled to compute it.

To enable Arcturus to describe a circular orbit on the heavens, of the same apparent size as the sun, would require, according to the foregoing table, about a thousand years. The length of time necessary to complete our knowledge of these enormous motions, is well-nigh appalling; but the patient working of generations upon generations of scientific observers will at last accomplish the stupendous work, and at some remote future epoch, the orbit of our sun, together with the most important of the other stars, will doubtless be as well known as the paths through space of the planets of our own little system.

W. G.

ON THE SINKING OF TWO SHAFTS AT MARSDEN, FOR THE WHITBURN COAL COMPANY.

By John Daglish, M. Inst, C.E.

The author of this paper (read at a recent meeting of the Institute of Civil Engineers) sketched briefly the Geological character of the North of England Coal Field, adjoining the sea coast. He then proceeded to describe the method of procedure adopted in the first instance at the Marsden winning, namely, pumping the water during the sinking in the ordinary way by three powerful engines actuating two sinking sets of pumps 30 inches in diameter, and three sinking sets 20 inches in diameter. By means of these over 12,000 gallons of water per minute were raised, being a larger quantity than had ever previously been pumped at one mine. Numerous large gullets were met with in the sinking in the limestone. At a depth of 150 feet from the surface the quantity of water overcame the capacity of the pumping appliances, and being strongly saline, indicated that there was an influx from the sea, which was only 400 yards distant. It was then decided to adopt the Kind-Chaudron process, which had been for some time in successful operation in Belgium and in France. The author described this process at length; it consisted first of a modification of the system of boring small holes extensively introduced by Mr. Kind in various parts of the world, and adapted to sinking pits of large diameter. At Marsden the shaft was 14 feet 6 inches in diameter. Secondly, of the lowering in of a cast-iron tube of rings of metal the full size of the pit, carefully bolted together and water-tight, The bottom ring was made telescopic when it reached the bottom of the pit; the remainder of the tube slid within it, and compressed a ring of moss by its weight (in the case of the Marsden sinking nearly 500 tons), from about 5 feet into 1 foot in thickness, forming a perfectly water-tight joint at the bottom of the pit. The water was then drawn out by buckets, and sinking resumed in the ordinary way. At Marsden, two shafts had been successfully sunk in this way, and coal was now being extensively worked and brought up the shafts which were quite dry.

THE THREATENING COMET.

We have been favoured with a great amount of interesting correspondence in consequence of our article upon this subject, and curious to relate the greatest portion thereof has been from clergymen and ministers of various denominations. It would seem that a great amount of needless alarm and agitation has been engendered in the various churches on this interesting subject from the injudicious remarks of some half-informed journalists, and perhaps slightly careless or thoughtless observations on the part of more scientific writers, when discussing their speculative theories. Such remarks not being clearly understood by the ordinary reading public, have been taken up and retailed in a highly sensational manner from a number of pulpits, to the no small perturbation of nervous hearers.

Of course all this is highly reprehensible; nevertheless, we must protest against blame being solely attached to one or two responsible individuals. It has been thought to be the proper thing by a goodly number of newspaper writers, to attack on this head one of the most hard-working and thoughtful prelates on the episcopal bench, we refer to the Bishop of Manchester. Now, so far from the Bishop desiring to be the apostle of any alarmist propaganda, the whole scope and object of his remarks from the pulpit was merely to shew that sometimes the speculations of persons accredited as scientific men, ran parallel with some of the mystical and poetical expressions of scripture. As is often the case, the reporters present on the occasion referred to saw fit to transcribe the illustrations used by the preacher, and entirely missed the real pith of the matter of application.

We refer to this point because we think that the Bishop has a real cause of complaint, and that we are able to put forward his Lordship's own view of the position; and also because we believe that the real fault is referable to some loose and perhaps hasty expressions in professedly scientific articles upon the possible fate of comets.

With regard to the sensational theories propounded, we are glad to see that some of the most excited prophets of cometary catastrophes are now fast modifying their views and acknowledging their convictions that any absorption of comets by the sun must be of a gradual and harmless character, similar to what was described in our article last month.

The Scientific Review

AND

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SESSION 1882—1883.

January 11th, "A Cursory Glance on Recent Electrical Patents," by T. MORGAN, Esq.

January 25th, Executive and General Council Meeting.

Subscriptions are payable to Mr. G. A. STRETTON, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts.

F. W. CAMPIN, Sec.

Proceedings of the Institute.

The points of Patent Law that have been approved by Members of the Inventors' Institute may be read in connexion with the various remarks made at the Dinner, especially those by Mr. Spagnoletti, viz., (1) Provisional Protection to be twelve months and not more than ten shillings cost; (2) Full investigation of Patented Inventions, and if possible non-impeachment of validity of Patents; (3) Reform of Patent Litigation.

Monthly Notices.

Tree Planting.—In the season of 1881-82 more than 3,000,000 trees were planted in Great Britain, out of which number Scotland claims about 2,000,000, England 600,000, Ireland 300,000, and Wales 40,000.

Meteorological Phenomena.—According to E. L. Larkin, on the 16th of April last there occurred simultaneously a magnetic storm, an aurora of unusual splendour, and an extraordinary agitation in the sun, 111 spots having been counted during the day.

Growth of Cereals in High Latitudes.—The northernmost place in the world where rye and oats mature is at Kengis, in the Swedish province of Norrbotten, forty-nine miles to north of the Polar circle, whereas the northernmost spot where corn is grown is at Muoniovara, ninety-eight miles to north of the circle.

Preservation of Honey.—Honey, according to A. Vogel, contains on an average one per cent of formic acid. Observing that crude honey keeps better than that which has been clarified, E. Mylius has tried the addition of formic acid, and found that it prevents fermentation without impairing the flavour of the honey.

Estimate of Gold Coinage.—The *Paris Bourse* estimates the total stock of gold in the world in use as coin or as banking reserves in one shape or other at about £580,000,000, of which total England has £126,000,000, France £136,000,000, Germany £80,000,000, and the United States £92,000,000. Other nations come in for shares varying from £800,000, in the case of Holland, to £30,400,000, in Spain's.

Pure Hydrochloric Acid.—Giudice prepares the *pure* acid, whether gas or liquid, for experimental purposes, by the action of sulphuric acid on sodium chloride, but adds to the former some oxidising substance like potassium bichromate of permanganate, or the black oxide of manganese. The gas is passed through mercury, contained in a Liebig's potash bulb, or other suitable apparatus, before it is passed into water or used.

Electrified Lily.—During a storm at Montmaurin, in the upper Garonne, M. F. Laroque witnessed a curious electric phenomenon. Looking toward a clump of lilies, he saw the highest plunged in a diffused violet light, which formed an aureole around the corolla. This light lasted for eight or ten seconds. After it had ceased, he approached the lily, which he found, to his great surprise, wholly deprived of its pollen, while the neighbouring flowers were covered with it.—*La Nature.*

Imitation of Glycerine.—In the *Union Medicale et Scientifique du Nord-Est*, Prof. Lajoux points out a fraudulent substitute for glycerine, which has been introduced into the French market. The ordinary physical character of the liquid closely resembles a fine specimen of glycerine; it, however, has a bitter taste, due to an impure sulphate of magnesium, and contains glucose. Quantitative analysis showed that the preparation was simply a saturated solution of sulphate of magnesium, with 160 grms. of glucose to the litre, to disguise the taste of the salt.

California Wine.—The *California Democrat* says that, notwithstanding the large dimensions which wine culture has attained in California, the American resident of that State has failed as yet to take to wine drinking as a habit. The Napa Valley is filled with luxuriant vineyards, but foreigners remark with surprise that on entering the inns of that section of the State they not only look about in vain to see wine drinkers, but are not always sure of being able to get wine to drink themselves. Strong liquors are still the staple beverages. Grapes are not much in demand, even for table use.

The Volta Prize.—The prize of 50,000 francs instituted by the decree of June 11, 1882, in favour of the author of the discovery which shall enable electricity to be applied economically in one of the following directions:—as a source of heat, of light, of chemical action, of mechanical power, as a means of the transmission of intelligence, or of the treatment of disease,—will be awarded in December, 1887. The *savants* of all nations will be admitted to compete up to June 30, 1887. A commission nominated by the Minister of Public Instruction will be charged with examining the invention specified by each candidate, and of recognising whether it fulfils the conditions required.—*Comptes Rendus.*

THE SCIENTIFIC REVIEW
AND
Scientific and Literary Review
INCORPORATING THE "JOURNAL OF THE INVENTORS' INSTITUTE."

JANUARY, 1883.

THE INVENTORS' DINNER.

The Inventors' Dinner, for Members of the Inventors' Institute and others, took place at St. James's Hall, on Thursday, November 30th, 1882. Amongst those present were Admiral Selwyn, R.N., Vice-President of the Inventors' Institute, who occupied the chair, H. Broadhurst, Esq., M.P., F. H. Varley, Esq., C.E., C. E. Spagnoletti, Esq., M.I.C.E., J. S. Farmer, Esq., C.E., C. T. Kingzett, Esq., F.C.S., J. Saxby, Esq., C.E., A. J. Beer, Esq., Mayor of Canterbury, John Smeaton, Esq., T. Waller, Esq., C.E., and other eminent Inventors.

In opening the proceedings, the Chairman said—Gentlemen, I stand here in the place of one who for many years filled this chair with honour to himself and with consideration for everyone around him. No one can occupy his place here without feeling that not only by his amenity of manner, but by the extensive and comprehensive nature of his great attainments on matters with which your Institute is deeply interested, and his unswerving probity, it was established beyond question that he was in no little degree one of the first men of his day. (Hear, hear). To many of us he was a personal friend, and a man whose judgment all revered throughout his life. To the Institute his death has been a very severe loss indeed (hear, hear); in fact, a loss that it will be long ere we shall be able to repair. With the late Sir Antonio Brady, it unfortunately falls to my lot to tell you of the demise of other supporters of this Institute, one of whom we did not know so well as we might have done if he had been a resident in London, I mean Mr. Aveling—a man who raised a great firm out of small beginnings; and another who was a warm friend also to this Institute, I mean Mr. Paterson—a working man, who shared the labours of our Society, bore his share of the heat and burden of its past, and whose loss will be deeply felt. I suggest that we fill a glass and drink it in solemn silence to the memory of those who have departed from amongst us. (The toast was duly and respectfully honoured).

The Chairman expressed his regret at the absence of the Duke of Manchester, the President, who wrote him the following letter expressing his utter inability to be present at the Dinner.

> "Dear Admiral Selwyn,
>
> "I find I shall not be able to attend the Dinner of the Inventors' Institute on the 30th. I hope you will be able to take my place," &c.

The Chairman also referred to the absence of Mr. Campin from their festive board, whose familiar face they all, he felt sure, missed very much. (Hear, hear). His absence was due to a severe illness, a statement they would all hear with regret. (Hear, hear).

The Chairman then proposed the health of Her Most Gracious Majesty the Queen, with all the honours. He also proposed the health of His Royal Highness the Prince of Wales and the other Members of the Royal Family. The toasts were loyally responded to.

He next proposed the health of the Army, Navy, and Volunteer Forces, which was drunk with enthusiasm.

The Chairman in proposing the next toast, that of the Houses of Parliament, and especially the House of Commons, coupled with the name of Mr. Broadhurst, M.P., said he included Mr. Broadhurst in the toast because he was the inventor's friend (cheers) and was one amonst the few who understood that to be the inventor's friend was also to be the working man's friend (Hear, hear). He would now read a few sentences from the speech of a man who, for those words alone, well deserved the name of statesman, Lord Salisbury, who in Scotland the other day said:—

> "Consider what it is which really concerns the industrial members of society, whether they are workmen or whether they are tradesmen. Great political measures touch them little. Even if you could suppose measures of great spoliation, which should divide the property of the rich, how little value could it be to each individual workman or shopkeeper in this great country. But what is of all things important to them is that capital should flow, that employment should exist, that wages should maintain a high level, and that the expenditure consequent upon the high level of wages should fertilise the channels of commerce. But capital will not flow unless there is confidence, and any system of political doctrine which tends to create animosity between the various classes of society is directed full and in front against that confidence which is vital to the existence of industry."

He would take leave to point and drive home that speech, as referring to invention. All industries arose and progressed by inventive genius. (Hear, hear). All new things owed their creation to the brain work of the inventor. He referred to the great work of Mr. Bessemer and others, by whose genius a whole population found occupation and sustenance. It was no exaggeration to say that an industry of that kind could employ profitably more millions of the population than could be so employed by any change in the Legislation of our Parliament. (Hear, hear). While legislation might effect a change in the distribution of property, legislation was powerless to increase the value and quantity of that property. But inventors set on foot new industries, which affect even the children of the country, and provide men, women, and children with profitable employment; and if the House of Commons would turn its attention to the anomalies complained of, and protect the inventors' brains, they would engage that in ten years' time after efficient protection had been given them, profitable work and bread for the whole population might be provided. (Cheers). The question was no longer the inventor's or the manufacturer's, it affected each unit of the population. Unless means were devised to compensate for that awful current which had set in from foreign countries, we might be cut down to the lowest unprofitable level by unfair competition. (The toast was duly honoured).

Mr. Henry Broadhurst, M.P. (who on rising was received with loud cheers), said the toast of the House of Commons had been drank very heartily, and he regretted that there was not some member of that House present more capable and more entitled than himself to return thanks. However, the Chairman in proposing the House of Commons had selected copious extracts trom the recent utterances of the Leader of the Opposition in the House of Lords; and now that Lord Salisbury was out of Commission, he would only hope that he was making considerable progress in public knowledge and politics, that he was using his leisure time to read up past history, and seeing how unwise it has been for men with whom he had been associated to have opposed many measures to which they felt called upon conscientiously to offer a determined opposition. (Hear, hear.) Referring to the House of Commons, that body had just so improved its machinery as to keep abreast with the requirements of the age in legislation, (hear, hear), or in other words, they meant not to be behind those he was addressing in invention—the old machinery being found totally incapable of discharging the calls made upon it. Now, one of the things under discussion in the House was on the subject of "Grand Committees." He asked his hearers to imagine a number of very hearty and very good foxhunters, good shooters, good fishermen, good lawyers, good philanthropists and people of that sort, being engaged in the discussion of the details of the Patent Laws. (Hear, hear.) Such a thing was so absurd that all would agree that the Bill would be much better if referred to a committee of men who knew something about the subject, to go thoroughly through the whole of the proposals, and report the whole measure to the House. (Hear, hear.) He believed that one of the first Bills to be referred to the Grand Committeee to be appointed upon Trade subjects would be that of Patents. If that were so it would be of great advantage to Inventors, for it would be about the only opportunity they had of getting a Bill dealing with the Patent Laws through the next Session of Parliament. With reference to the proposed reform it was difficult to induce the Government to do all that Inventors required. No private Member would ever be permitted by any Government to deal with such a subject, which, to a considerable extent, affected the revenue of the country; and all that private Members and Public bodies could do, was to formulate their desires and demands in the shape of a Bill, in order that the Government might know precisely the mode by which they were expected to deal with the question. Mr. Anderson had prepared a Bill which, if not wholly, is to a considerable extent, drawn by lines required by the Inventors' Institute. The Bill had undergone slight modifications Session after Session, dictated by the experience of those in charge of it. Mr. Anderson was a man of great experience in Parliamentary matters, and whatever he considered necessary for its success would be acquiesced in by many who supported him on that question. There was another Society which could not claim to represent the Inventor to such an extent as their Institute, (hear, hear), that was the Society of Arts, who had prepared counter proposals and submitted them to Parliament. What he understood in the Patent Laws to be more than anything else necessary was, the simplification of the obtaining of Patents, and the chief thing in the first part of the process of obtaining it was the expense. (Hear, hear.) Now the Society of Arts proposed a total charge of something like £7 10s. before they could secure the Patent. (Shame.) Well, that was a matter for their consideration as Inventors, whether it was a shame. He did not agree with it at all. Mr. Anderson's Bill, with which his own name had been associated during the past three or four Sessions, proposed a charge of £4 only. The Society of Arts proposed to charge £28 for about eight years' protection. His Bill gave something like twelve years' protection for £24. He did not hesitate to say that Mr. Anderson's Bill was one which recommended itself most strongly to all friends of Patent Law. Next Session it was almost a certainty that a Government Bill would be presented, and then would be the time for Patent Law Reformers to rally their forces, and submit to Government such amendments as they could agree upon generally. (Hear, hear.) He believed the Government Bill, if it did not cheapen considerably the cost of Patents over the whole period, would, at any rate, lessen considerably the charges of the first eight or ten years. The difficulty Inventors had to cope with was, that although their numbers were large throughout the country they had very little means indeed of concentrating their influence upon political parties, and that was what they stood in need of. He could answer for it that they had a number of good friends in the House who would do their best to improve the Bill when introduced, but their efforts would not, he feared, be of much avail unless they had some outside opinion to back them up. To show the interest taken by the House formerly in the cause of the Inventor, when the late Mr. Hinde Palmer made a proposal in favour of a Patent Model Museum the thing was pooh-poohed, and only one or two supported him. In fact, the Patent Law Reformer was looked upon by the regular politician as a bore, to be got rid of as quickly as possible, and to be silenced by some means or other with the least concessions afforded him. That was a most unfortunate state of things. What was wanted was to get together all friends of Patent Law Reform without loss of time, and be prepared for next Session. In conclusion he felt sure that between then and the following twelve months, the Law of Patents would have been disposed of for many years, and therefore it was all the more necessary that a great and a final effort should be made in order to secure freedom and opportunity for the poor Inventor as well as for the rich. (Loud applause.)

Mr. Spagnoletti—Invention is an attribute of human nature originally. We find invention in everybody more or less. We see it in a small way even in children. We see it in the frugal and intelligent housewife, where, by her arrangements she saves in the expenditure on the natural comforts and necessaries of life. Also in the various parts of Art and Science, and in the artist who by his wonderful talent changes his works by the beautiful vision presented to us whether in the face or a well known spot. We get it also in the musical profession, where we get the Inventor to charm and delight our senses; but here we have what I may call inventive properties—that is, the person who not only invents for himself and his immediate necessity, but he gets a key to the position of the whole necessity of his fellow creatures. (Cheers.) His power of invention is still more enhanced by the power of appreciation of learned subjects and principles which he may have to conceive than any one particular group; and it is in this way that the true Inventor will have to be regarded. One of the great desideratums in Patent Laws is economy in the first place. (Hear, hear.) Secondly, more time is required for provisional Specifications, the time allowed, six months, not being sufficient. In fact it is of little or no use. (Hear, hear.) By the time you have got your ideas in a group six months elapse, and you are obliged to give your notices, and so proceed before half your experiments have been tried; which ought to be allowed to bring it to a successful issue. (Hear, hear.) Another point which is almost more important still, that is, in the practical experience which I gain by our Inventions we find that we may hit upon some little bit of machinery which may be applied to the machine itself, and so make it more perfect and complete. Now, it is hard upon the Inventor that in order to secure a little bit to the improvements he has made before he must go to the expense of the additional cost. It would be an enormous advantage to the Inventor if he could by giving a description of this addition, and paying a reasonable amount have that attached to his Patent (hear, hear) to continue as long as the Patent lasts, and as long as he pays the fees from time to time. The time might be limited to a certain period as to the advantages that might be allowed for these additions, and after a certain lapse of time that extra privilege might perhaps cease when it becomes necessary for him to take out a fresh Patent. I think if these things were brought into force, that great advantages would be accomplished in dealing with our work. I find from experience, and this is the experience of others too, that it takes time to get the Patent worked out. You cannot induce other people to believe that what you say is right; they want some practical proof themselves of the value and practicability of an invention. (Hear, hear.) When that is done then the invention begins to move, and to get that invention to move I find it takes almost a period of three years. I think that would be a very good period at which to limit the amount of period. (Cheers.)

Mr. Standfield declared that the Inventor had done many times more than the statesman in cheapening the loaf of the working man of this country, by inventing that machinery which enabled the corn trade to be carried on at reduced cost. The statesman only took off two shillings from grain to put it on to something else. He dwelt at length on the improved machinery used in ocean steamers carrying cereals, on the better class of agricultural machinery, on the effect of the improved railway systems, and a thousand and one other things the production of the Inventor's brain. If the working man now enjoyed a much higher rate of wage than he did years ago and shorter hours, it was due to the Inventor, who had supplied the loom or some engine which enabled him to do more work in six hours than he could do in eighteen hours years ago. (Hear, hear.) If the working man could be made to understand that it was the Inventor who had increased his pay and shortened his hours of labour, they would not be slow in returning to Parliament men who would benefit the Inventor. (Hear, hear.) He predicted that if the cost of Patents were reduced one-fourth, all things would be cheapened and the Public Exchequer more largely benefited. He referred to the Patent Law Amendment Act of 1882 as the starting point of the Inventors' prosperity. Previous to 1852 only 500 Patents were taken out, now they averaged 3,000 per annum. He urged that Patents should be granted at £5, with an annual payment of £1. He thought if the Institute went to work steadily and made it clear that it would enrich the exchequer and be more profitable and beneficial to the people to grant Patents for twenty-one years at £6 per annum, that they would be very likely to get that Bill passed as one of another character. (Hear, hear.)

Mr. F. H. Varley remarked that there was a growing public recognition of the necessity of encouraging and fostering the Inventor's interest. The appointment of Grand Committees by the House of Commons to look after matters affecting trade would greatly tend to the realization of the Inventors' hopes of a reform in Patent Laws.

It was a truism that Inventors were real sources of revenue to the country of their adoption. (Cheers.) If we did not grow enough corn in our own country we must buy it; and to get the money to do so must depend largely on works of Invention at home. (Hear, hear.) He trusted to see the School Boards extend a practical education to the people as the surest means of placing the working classes on the same footing as their kindred in Germany and America. Inventors were really the backbone and the intelligence behind our great commercial systems. The inventors' question is the life's blood of the nation, therefore it must be approached in a proper manner and dealt with completely; but no Patent Law Reform would be effective which had a taint of class legislation. It must be as applicable to the poor Inventor as to him who might be as rich as Crœsus. It was in practical inventions that the wealth of the country lay. (Hear, hear.) He hoped there would be a united front. He thought Inventors were too divided by crotchets. There was a want of more unity. He was not satisfied with the Bill brought forward by the Council of the Society of Arts, though he was glad the Council took credit for the measure which was not called a Bill of the Society of Arts, but of the Council. It was a wonderful step in the right direction, and he gave them every credit for the sympathy it displayed for the Inventors' cause, but their Bill did not go far enough. In conclusion, he hoped that those connected with political movements would take this on their programme and help in the cause which in his judgment was the most momentous that the English Legislature ever had had to deal with. (Loud cheers.)

Mr. A. J. Beer (Mayor of Canterbury), observed that he had been a Member of the Institute for many years, and gloried in his connection with them. He sincerely hoped they would have more encouragement. They used their time, brains, and money to secure to their fellow man the grand results of their inventive genius. He was himself an Inventor, but got nothing by it. As their great desire was to benefit the public, he trusted their efforts to reform the defective Laws of the present would be more appreciated in the future generally by the people. He hoped that the promised reform would bring the country more Inventors, and even a better class of them if it were possible. Parliament he considered had greatly neglected to guard and protect the Inventions of those men who spent a life in their perfection; and he trusted that Institute would bring all its influence to bear on the House of Commons and the people generally in order to create further fruits which they so richly deserved. He drank success to the Inventors' Institute, and hoped it might continue to flourish. He coupled the name of Mr. Saxby with the toast, which was duly honoured.

Mr. White, speaking on behalf of Mr. Saxby, remarked that it had been said that England must send her manufactures to America who supplied us with corn; but how could England send her manufactures to America, when they were met with a prohibitory duty of sixty per cent? (Hear, hear.) It was of the greatest consequence that England should be supported by developing her own resources without looking to America and the way to cultivate those resources was to bring forth the best possible Patent Laws, and not one necessarily to be remunerative to the Government, but to the Inventor. (Hear, hear.)

The Gallant Chairman, having proposed the health of the Press, which had done much, he said, to bring the Inventors' cause before Parliament and the country, Mr. Shelley duly acknowledged the toast, and Mr. M. Zingler having proposed a vote of thanks to the Chairman for presiding, the latter in response thanked the Dinner Committee for the part they had performed in bringing the company together, whereupon the proceedings closed.

MARINE CATASTROPHES.

It is not our intention to enter into a history of dreadful accidents at sea, or any description of the horrible details attendant upon such events; as, although such things may be proper subjects for sensational newspaper reports, they do not, we apprehend, need in any way to be enlarged upon here. Our object is rather to investigate the causes of such accidents, and to see how far means can be devised—first, for their prevention, and secondly, for a reduction of their disastrous consequences to a minimum when inevitable. In doing this we wish to state that in describing any novelty of construction as a means of saving life under sudden emergencies, although they may be the result of long and patient thought, we shall not do so with the intention of acquiring any proprietary right therein, but solely with the desire that such will be freely adopted by our shipbuilders and shipowners, and if we can thus be the means of saving the lives of some of our fellow-creatures, we shall deem the same sufficient reward.

Let us look at some of the principal causes of marine catastrophes, which we will divide for convenience into the following, viz:—Foundering at sea; wreckage upon the coast; fire at sea; collisions at sea in fogs, and collisions in narrow channels or in river traffic.

If we take these in the order they are given, we commence with Foundering at Sea. This may be said chiefly to be dependent upon two causes; either the springing of a leak by the opening of the ship's seams, or other accident, or it is caused by the vessel capsizing in a squall under a heavy amount of canvas. In a well appointed ship the former of these emergencies is fairly provided for in an adequate supply of good boats, as in these cases there is mostly plenty of time between the first appearance of danger and the going down of the ship to launch and even victual the boats, without much hurry and confusion.

In the case of fire at sea, the time allowed for escape is similar to that in the foregoing case. The amount of time gained, and the probability of bringing the ship into port, depend entirely on the power and efficiency of the same apparatus, viz., the pumps—in the one case used to empty the ship of water, and in the other to put out the fire. Yet, even here we have to note the fact that there are very few ships go to sea which carry passengers, and at the same time have a sufficiency of boats to be able to take all those passengers as well as the crew from the ships; and if it were not for the fact that in the cases now alluded to, much time is given by keeping going the pumps, during which it is possible to construct temporary means of flotation, such as rafts, &c., more lives than at present would be lost.

But when we come to the capsizing of a ship in a squall, the striking of a ship on the coast, a collision in a fog, or a collision even in a narrow channel, there seems to be absolutely no means whereby life may be saved, which is at all available by the persons (except in rare cases) who are precipitated into the water. And this is entirely because of the suddenness of the accident and the little time usually allowed between the first appearance of danger and the final plunge.

There is no doubt that many of the accidents which now happen could be prevented if a better understanding, and at the same time, a better precautionary system existed than at present. Nevertheless it is doubtful whether any system can be adopted which will entirely prevent catastrophes at sea and in rivers, especially as traffic increases; it therefore becomes of the utmost importance that adequate means of saving life be at all times provided, and available for use when the loss of a vessel becomes inevitable.

We know the exceeding difficulty under present arrangements of preventing these accidents, from the fact that the means at our disposal for the stopping, turning, or backing of a vessel with control, are in no way commensurate with the speed ahead we have obtained and carry into practice. Indeed it is obvious that we have here a great field for invention and improvement, and we trust that before long some of our inventors will be able to point out the remedy for this evil by giving us, first, a steering apparatus which shall operate instantaneously, and shall be as effective at the "slow," the "stop," and "back" as at the "go ahead," whether the vessel is under the influence of a current or tide or not. And by giving us also a powerful back-water arrangement, which shall enable a vessel to be brought to a stand even in a strong current, in an exceedingly short space of time. With regard to the latter we believe important experiments are already in progress.

But we think most will agree that this result, although so very desirable, is a work of time, not by any means likely to be brought to rapid perfection; that in the meantime something ought to be done to reduce the risk consequent on our present imperfect arrangements, and that this should first be based upon the existing state of affairs.

Now much has been done to prevent the foundering of ships at sea by the system of inspection adopted in consequence of Mr. Plimsoll's crusade; yet more can be done by rendering that inspection still more rigid, as many ships are afloat which may be considered safe enough for fair weather, but which would be utterly unfit to withstand a heavy storm.

Nevertheless it is not in connection with disasters of this kind that improvement is the most sorely needed, nor with that even of fire at sea, although many precautionary measures are both desirable and practicable on this head, but rather for those dreadful occurrences which come so suddenly upon men, that there remains no time available for anything but a frightful struggle for individual life.

We will deal with river catastrophes, and the means for their possible prevention. In the crowded thoroughfares of a great city, the drivers of the various vehicles are very properly restricted as to speed by the municipal authorities, which fact an occasional summons for furious driving makes apparent. Also in those thoroughfares, at dangerous or difficult places, responsible officers are placed to regulate and control the movements of the various public and private vehicles, although there is in existence a well-defined and universally-understood rule of the road. Now, if this is found necessary for small vehicles on land, which seldom contain more than thirty or forty passengers, how much more is there a need for some such restriction and supervision on a crowded river like the Thames?

A river police is already in existence, and all that is needed is to adopt the machinery, ready made, to the requirements of the case. On all our railways we have at junctions, stations, &c., along the lines signal-boxes and signal-men who take the complete control of the approaching trains.

Now, what we suggest and what we think the public ought to demand is, first, that all steamers going with the tide, especially ebb tides in rivers, should be restricted to a moderate speed, and that large or sea-going steamers (presumably screw ships) should be restricted to a slower speed than mere river boats, which have, as a rule, more control over their movements; and, second, that at all the sharp turns or bends of a crowded river there should be stationed a police boat, with full power to control the traffic at that point, It is quite obvious that two ships approaching a sharp turn in a river are quite unaware of each other until they round the point, when it is sometimes found impossible to clear each other; whereas, a police boat stationed opposite the point would be able to see both vessels in plenty of time to quietly signal each on a course of safety. Of course, to make such a system effective, there should be power given to summon captains for any disregard of the signals, &c.; but when we have granted this. it is very doubtful whether any would be so foolish as to leave unheeded a warning involving such fearful issues as that of a collision. At the same time we should have, in case of unpreventible accidents, most probably witnesses capable of giving reliable evidence on the subject.

Another advantage of this arrangement would be the fact that such signal stations on a river could be provided with all the ordinary or special life-saving apparatus, which could be kept ready for immediate use in cases of emergency; and, as these emergencies mostly arise in dangerous localities, the appliances for humane purposes would probably be at all times where wanted. We would, however, have it clearly understood that, in suggesting this means of prevention of accidents, we do not pretend to foresee all the minute difficulties to be overcome in the carrying out of the idea, but we do say that such difficulties are of minor consideration; that the time has come when a plan of the character here foreshadowed is necessary to be carried out, and that the authorities who have the supervision of the large and busy rivers cannot neglect such a simple and practicable suggestion, now that it is pointed out without incurring grave responsibility.

We would suggest that at night and in foggy weather, sound telegraphy should be adopted, and this also supplemented by lights, which might indicate to another vessel the helm under which one approaching in an opposite direction intends to sail, as in times such as these it is exceedingly difficult for one captain to make out the intentions of the other, and it often happens that when the one has come to a conclusion as to the intentions of the other, and has given his orders accordingly, that he finds to his dismay the very opposite course has been taken by the approaching ship.

Having said something with regard to prevention of this kind of marine catastrophes, we wish now to call attention to the means of saving life when such calamities become inevitable, and we apprehend that such will occur, although on much rarer occasions, when all possible preventative measures have to be taken; for no system can prevent wilful negligence, or make up for utter incompetency. which on certain rare occasions will, while human nature is as it is, now and again manifest themselves.

Let us take any passenger steamer or sailing vessel going to sea, and examine what the means provided for saving life in case of an accident such as we have been considering. First, she has a certain number of boats of varying capacities, and secondly, she has a certain number of life buoys. But the thing which strikes the ordinary observer on board ship is the utter incapacity of these to provide safety for say one quarter of the people on a passenger ship, even if they could all be successfully put into requisition.

As a matter of fact. we know that in all sudden emergencies of which we have any record, the boats and buoys of the ship in question have, as a rule, been of no more value than if they had not been there, and for a very obvious reason. To keep a boat in good order it is necessary to protect it with a canvas or other covering; and to prevent it from receiving or doing damage it must be firmly secured to the deck or bulwarks of a ship. As a consequence, when wanted, a certain amount of time is lost before the boat can be got ready for launching, and then the actual launch has to be accomplished, the time for which is not allowed by the nature of the case The same in a less degree applies to the buoys: although if all the buoys of a well-found ship were rendered available, they would not save many, as the disparity is so great between the number of passengers usually on a ship (especially river and channel boats, where the greatest danger exists), and the carrying power of both buoys and boats, that the fact of their uselessness does not affect the problem.

Seeing, therefore, that the boats and buoys of a vessel are in no way available in a sudden emergency, we are brought face to face with the fact that there is really no reliable means whatever for saving life in these cases. That being the case, we think it will be admitted it is high time some means were provided. Now let us examine the conditions which any such means must fulfil to become of any real value for the purpose intended. We take them, or the most important of them, to be as follows:—The apparatus must be *always* in readiness; must be simple and durable in the extreme; must not interfere with the required deck space, or be in the way of the ordinary movements on board, or in any way impede the action or requirements of the ship at wharfs or quays, or other landing places; and, lastly, and of the most importance, it must be of such a character that, in case of the ship going down, the life saving apparatus will be left floating on the water, and not taken down along with the vessel, as is the case with the boats and buoys, in consequence of their being lashed fast.

After careful thought we have come to the conclusion that the best way in which all these conditions can be fulfilled, and in fact the only way, is so to design the various requirements on board ship that they themselves will become of life-saving character. We are aware that this has been in a measure proposed with certain articles; but as these proposals have usually involved the various india-rubber ideas with which we have so long been afflicted, we do not think it necessary to further refer to them. Anything which requires the least preparation, inflation, or action of any kind when wanted for use, would, in our opinion, be worse than useless. Furthermore, materials which can be so acted upon are very unreliable, and would most likely be found at the critical moment, even if there were time to make the necessary preparations, to be in such a damaged condition as to be of no value when put into action. We would, therefore, propose to form the upper portion of the bulwarks of the ship of loose sections, composed chiefly of hollow thin metallic tubes, divided into compartments by diaphrams, the sections to be, say about 12 feet long, each divided into a number of compartments and of any suitable form, and provided with projections on their under sides, so as to be fitted on to the place of the top rail of the bulwarks, as a substitute therefor. These sections thus formed would have, when immersed in the water, considerable floating power—in fact would be like so many pontoons, and should be provided with cords in loops along their sides to which persons could cling for support.

Now as these appliances would be in no way attached to, but merely fitted on, in a way that they would be secure against side thrust, and yet at the same time capable of lifting out of their places in a vertical direction, it will be evident that in the event of a ship going down they would be lifted out of their places by the action of the water, and so be made into a number of floating tubes capable of holding up a considerable quantity of people, and yet in ordinary times would answer the purpose of the top rail, and occupy very little more space than the hard and heavy wooden ones often used in steamships. We would also construct the whole of the seats on the deck of the ship in the same manner, so that each seat would be made to float as many persons, and more, than were accommodated with sitting space thereby. The object of dividing these metallic tubular forms (the exact shape of which could be best decided by a series of experiments) into compartments is twofold, viz.; to prevent their becoming useless in the event of accident causing a leakage, and to obtain the required strength with exceedingly thin metal.

Underneath every seat and along the entire length of the bulwarks, and lying on the deck, other tubes of the same kind, and temporarily secured in the same manner, could be provided, which, added to those already mentioned would, we believe, provide means of support in the water for the whole of the passengers of a ship carrying only that number for which she might be registered.

The materials we would suggest as the most suitable for the purpose are sheet zinc, or thin galvanized iron, formed into suitably-shaped tubes, and made water-tight either by soldering or riveting the joints. The underneath projections we would suggest, should be of the simplest character, say, conical or taper-shaped pegs or spikes, of sufficient length to give the required stability in ordinary use; and yet such as when the tubes were lifted by the volume of water necessary to float the same, would not in any way lock or get choked in the holes or recesses provided for their reception. We would also in sea-going vessels fit the bulwark tubes with hooks and rings or slots, so that in case of foundering at sea they could be joined together either before or after taking to the water, and thus form the framework of a pontoon raft capable of carrying a goodly number of people. The great advantage of this arrangement would be the perpetual readiness for a sudden emergency. Passengers would become rapidly acquainted with the simple character of the means of safety, and would only have to cling for support to, say the seat they were sitting upon, to the cords along the top of the bulwarks, or to the second line underneath; and as these things would extend all round the ship, much of the panic and confusion of rushing after a means of escape from sudden danger would be avoided.

All this is exceedingly simple and easy to be understood, but we maintain that it is only something so simple as to be almost self-evident which will be of value for this purpose.

There can be no doubt but that our shipbuilders could at once construct vessels fitted in this manner, and that every ship and steamboat already afloat is capable of being so fitted at once, and that the way being pointed out, we think the public have a right to expect from shipowners this degree of safety, at least, until something better can be found.

W. G.

THE AGE OF ELECTRICITY.

Prof. S. P. Thompson, in a lecture delivered at University College, Bristol, says that it is the fashion among ethnologists to classify the successive stages of development in the primitive races of mankind by reference to the kind of implement which marked the degree of civilisation to which they had attained. A chipped flint arrow, a bronze spear-head, an iron dagger, are typical of the several grades of advancement in material civilization which we familiarly name the age of stone, the age of bronze, the age of iron. To these three primitive ages you must allow me to add three others, equally well defined—the age of gunpowder, the age of coal and steam, and the age of electricity. The world is even now entering upon a new, and I am fain to believe a happier, age, wherein, while delivered to a large degree from the darker aspects, we shall enjoy to a degree hitherto unknown the advantages of machine-aided production. Our machinery will be driven, not by steam, but by electricity; for electricity will be our servant to do the hard work of the world in the coming age. For a quarter of a century we have harnessed that messenger, more nimble than fleet-footed Iris, to convey our thoughts. We have but lately discovered that electricity could also convey the actual tones of our speech. It is electricity that rings our bells, that silvers our pewter and gilds our pinchbeck, that fires our torpedoes, and brings Greenwich time to our clocks. True, these are light and easy duties, but it has taken us many years to adopt in practical life these simplest applications. And, mark you, the delay is not to be imputed to science, for science has known most of these things for forty years. Mines were fired by electricity in 1749; electroplating with silver was discovered in 1805; an electric telegraph was in actual operation in London in 1816; electric bells were invented in 1834; electric clocks were made in 1840; and speech was transmitted by an electric telephone in 1861.

But, familiar as are these services to mankind, there are other services of a very important nature which electricity is perfectly competent to perform, which, unless the world has grown wiser, will not, I suppose, be generally adopted for the next forty years. Electricity can bring us a magnificent and economical light. It can smelt our most refractory metals. It can bleach our cottons and print our calicoes. It can detect base coins without cutting them, and can discover a bullet in a wound without probing it. It can stencil our circulars, grind our coffee, gather our apples and walnuts, protect us against burglars, turn our sewing machines, drive our tricycles. Nay, it can perform much heavier work. It can turn lathes, saw timber, grind scissors and knives, plane planks, propel tramcars, and, as I can personally testify, can furnish motive power of a very effective kind to an iron boat. Surely we have reason to say that the age of electricity has already begun. The success of primitive attempts to utilise electricity as a motive power was not very encouraging, for their cost was great and their power weak. The fact was that though the machinery—on a small scale at any rate—was ready, the time was not ripe for it. Compact and light in weight, these little electric motors presented, for light kinds of work, an enormous advantage over steam engines; yet these advantages were far outweighed by the consideration that the cost of generating electric currents in the voltaic battery was so enormous as to be practically prohibitive.

The great stride which has brought so many of the possible applications of electric currents into the region of practical problems is due in its origin to the genius of Faraday. With the invention and perfection of the dynamo, between the years 1862 and 1872, a new range of possibilities was opened out. Electric lighting, to which the real obstacle had been all along the extravagant expense of producing electric currents, at once began to develop, and the Jablochkoff candle, the Siemens lamp, and the Brush lamp, which sprang almost simultaneously into existence, found themselves shortly confronted by a host of brilliant rivals for fame. Then first it became clear that electric currents might be laid on from house to house in order to supply domestic electric lights. Little lamps of the requisite compactness and brilliancy were speedily perfected by Edison and Swan, on the lines of an old invention of thirty years back, impracticable then, practicable now by reason of other advances in science. The vast possibilities opened out by the fact that a simple wire may convey electric currents to any distance now began to assume their true importance. The electric transmission of power to any distance, and the possibility thereby of utilising some of the waste forces of nature, became a burning question. The invention of the electric accumulator, by Planté, in 1860, and its improvement by Faure, in 1881, suggested the further cheapening the cost of electric currents by providing a means of thus storing the intermittent energy of waves and winds. The electric railway made its appearance in Berlin, to be followed by the electric tramway of Paris, and various projects for electric railways elsewhere. Electric industries of all kinds grew and multiplied; in fact, with the invention of the dynamo-machine we leaped into the age of electricity with a sudden bound.

Now, as the first achievement in the age of electricity appears to be the spread of the electric light, I will speak of that development first, though it is not, in my opinion, the most important. The blaze of the electric-arc light can be maintained by the consumption of a far smaller quantity of coal than would be required for the production of an equal amount of light by gas. So far there is economy—real and not small. But it may be said, "We don't want such overpowering displays in our houses even if we could afford them. There can be no economy in using a light far too brilliant for comfort." It is here that the incandescent lamps, such as those of Swan, Edison, and others, come in to give us exactly the brilliancy we need. Here, however, we are met by the disappointing circumstance that the very same electric consumption which will give us one blazing arc light of one thousand and more candle-power will, when applied to light a score of incandescent lamps, only give to the latter a brightness of eight candles each; or, in total, one hundred and sixty candles. It is clear, then, that the economy of small incandescent lamps is a different thing from that of arc lights. And I am quite certain that up to the present time, if any one has fixed incandescent lamps in his private house, and has erected his own dynamo and steam engine or gas engine to feed his lamps, he will have found no saving over his gas bill. I say this with less hesitation, because, when the circumstances are looked at narrowly, it will be seen that for a fair discussion of the question of economy, the comparison is not a fair one. To set up little electric works of one's own in one's own house cannot possibly be as cheap a method of generating the electric current as to have it generated at central stations on a large scale by large and economical machinery. No sane man would think of saving on his gas bill by setting up small gas works in his cellar, and by building a private gas meter in his back garden. The fair comparison must be made between gas as distributed from a central station on a large scale, and electricity as distributed from a central station on a large scale. That large scale distribution has, so far as I am aware, been yet only attempted in two places—New York and the Holborn Viaduct in London—and in both cases a system which is not necessarily by any means the best, or most economical—I mean Edison's—is the system tried. Yet I look forward with the greatest confidence to the results of those experiments, as showing not only that electricity can be distributed on a large scale, but that it can so be done with economy and profit. This regular and systematic distribution of electric currents on a large scale, by means of conductors laid along the streets, is the first step to the further economic applications of electricity, and is becoming now a pressing necessity of the time. A century hence a supply of electricity will be just as essential as a regular supply of gas and of water has become to-day; a hundred years hence the town without an electric supply will be deemed as badly off as nowadays a town which has no railway or telegraph. A general system of electric distribution is needed, not for electric lighting only, but for hundreds of other purposes of which we now dream little. Once let such a system be established, and we shall see how soon it will be found that there are many kinds of additional services which electricity can perform for us. When it is possible thus to obtain power by merely turning on a tap, there will be an enormous impetus to all kinds of small machinery. Motors to work sewing machines already exist, and would be used literally by millions if the source of electricity were but at hand, in the form of a friendly wire always ready to bring the needed power. If we have a system of electric distribution, lifts or elevators will be multiplied. An electric lift is both simpler and cheaper than a hydraulic lift, which will probably be suspended entirely at no distant date. Indeed, there are many hydraulic appliances which must at a very early date be superseded by electric machinery. Again, the establishment of a town supply of electricity will tend unquestionably to develop the industry of small workshops and home workshops, where a little power is required. The smallest electro-motors may be made just as economical as are the largest. There is, moreover, another point in their favour. They may be made far smaller, lighter, more compact, and far cheaper than steam engines of corresponding power. It is certainly possible to construct an electric-motor of two-horse power for a cost of ten pounds, and such a motor would be ample for the purposes of many small workshops. Why do we not, it may be asked, hear and see more of these little machines if they are so excellent? Why do not people adopt them? The answer is simply, they cannot be used until we have a central supply of electricity. I do not hesitate to affirm that such motors will be found to present an enormous economy in comparison with steam engines of equal power.

It is clear, then, that electricity offers an enormous future to small motor machinery. A further economy is, indeed, possible. Electricity will travel any distance along wires without sensible loss, provided those wires be thick enough. Instead, therefore, of erecting our steam engines at a central town station, where ground is dear, and where we shall pay dearly for transporting coal, let us put our steam engine and dynamos at the pit's mouth, and transmit our electricity to town through a stout copper cable. The saving of freights would much more than pay the interest on the cost of the cables required.

One further step in economy is also within the range of possibility; and that is to use water power or tide power to drive our dynamos. If the problem of utilising the tides remains yet unsolved for want of suitable tide mills, that of utilising the power of waterfalls by turbines is already solved, and only wants putting into effect. Niagara is not yet harnessed to the car of electricity, and is possibly too far off to supply Great Britain; but there are waterfalls enough in Scotland and in Norway to satisfy our wants for a long time to come. Of this at least I am convinced, that we do not yet realise the hundredth part of the future services which electricity can render to us when once it is supplied wholesale. Before the electric age is over, our knives will be polished, our shoes cleaned, our mangles driven, our coffee roasted, our potatoes pared, and our mincemeat chopped by the self-same agency that will bring light into our dwellings. In all kinds of machinery, small first, large afterwards, we shall see a complete revolution! In a very few years we shall see electric governors replacing the rotating governor balls for regulating the power of steam engines.

The locomotive steam engine is irrevocably doomed. Why should we employ an enormous and expensive lumbering mass of metal, loaded with boiler and coals, and burning four pounds of coal per horse-power per hour, to draw our trains, when we might equally well draw them by electric-motors of one-tenth part of the total weight, drawing their supplies of power electrically from a large and far more economical stationary engine at the end of the line? There is every argument in favour of this radical change—economy both in prime cost and in actual working, safety, and certainty of action. But railway directors do not yet know or realise the magnitude or certainty of the impending revolution.

Having hinted at the prospect of electric power superseding steam on the Metropolitan Railway, Professor Thompson continued: Setting aside all that deals with electric telegraphs and telephones, and confining ourselves only to the industries connected with electric lighting, the manufacture of dynamos, and of electric motors and their appliances, we shall find that in the electric industry to-day there are employed in England alone something like five thousand persons. Practice of the actual work of the shops is of course outside the range of the operations of such a college as ours, but the work of the electrical laboratory is just as truly within our range as the work of the dissecting-room is within the range of the medical school. I look upon education in matters electrical, indeed, as a pressing necessity of the time. That nation which can earliest establish such a system of distributing power among its artisans will be placed in a most advantageous position for production, and such a nation will reap its reward in the rush of commerce to its doors. That city which rises to the golden opportunity in store will in like manner reap its due harvest of returns.

AMERICAN PRACTICE IN WARMING BUILDINGS BY STEAM.

By the late Robert Briggs, M. Inst. C.E.

Originating about 1840 with the late Mr. Joseph Nason, the application of steam to the warming of buildings in the United States extended very rapidly, the apparatus being constructed of small and comparatively inexpensive wrought-iron welded tubes, which combined a large extent of heating surface with great strength, and with facility for transmitting heat in any direction from a central source. For securing durable steam-tight joints, the tube-ends were made with tapering screw-threads, and a paste of white and red lead was applied in screwing up. The couplings or sockets were made of cast-iron, and were tapped taper to fit the tube ends; excepting only the straight couplings, for connecting tubes in the same straight line, which were of wrought-iron and tapped parallel. A table was given of the standard dimensions for the tubes, throughout the range of sizes in use; and a scale for all the dimensions of the corresponding cast-iron couplings.

The steam was supplied either by boilers of the horizontal tubular or Seguin type, or else by the Babcock and Wilcox water-tube circulating-boiler with horizontal steam-drum overhead; either kind was practically safe from disastrous explosion. The steam circulating through the warming apparatus was either live steam direct from the boiler, or exhaust steam; the two were frequently used in combination, the latter being rarely employed alone. When using live steam, the circulation was either closed throughout from communication with the atmosphere, or was open to it at certain places. In the former case the distribution of the heat was effected either by separate supply-and-return-mains, or else by a single main for both supply and return, either with or without a longitudinal partition inside it for separating the outward current of steam-supply from the return current of condensed water. In open circulation a supply-main conveyed the steam to the radiating surfaces; whence a return-main, suitably trapped for preserving the steam pressure, conducted the condensed water either into an open tank for feeding the boiler, or into a drain. These two systems were most generally combined in any extensive warming apparatus. The steam stop-valves, known as "globe" valves, were disk or poppet valves, worked by a screwed spindle; this construction was introduced by the author in 1849, and was immediately followed by all makers.

In respect to the radiating surfaces for diffusing the heat, three distinct classes of apparatus were in use. Firstly, apparatus for warming room by direct radiation from surfaces exposed in the rooms themselves. Secondly, apparatus for indirect warming by currents of air; the heated surfaces were placed in a chamber, through which a supply of air passed on its way into the room. In either of these two methods was the warming accompanied by any systematic ventilation. Thirdly, apparatus for both warming and ventilating, arranged so that the warming should take effect upon the whole of the air admitted for ventilation. The temperature comfortable to Americans in cold weather was about 70° Fahrenheit on the Atlantic coast, rising to 80° or 85° for inland localities. In warming by direct radiation, the practice for many years was to arrange the steam-pipes in lines or groups along the bottom of the outside walls or under the windows. But the most recent practice, for rooms in mills, was to suspend the direct radiating pipes in rows overhead. Although the heat would here apparently be expended in the top of the room, yet very satisfactory results were thereby obtained, both in equability of warming and in efficiency of radiating surface.

The radiators for warming by direct radiation consisted usually of so-called "coils," composed of $\frac{3}{4}$-inch and 1-inch steam-pipes, arranged in parallel lines and coupled to branch tees or heads. Sometimes short lengths of pipe were coupled by return-bends, doubling backwards and forwards in several replications one above another, and forming "return-bend coils;" when several of these sections were connected by branch tees into a compact mass of tubing, the whole was known as a "box-coil." In vertical-pipe coils a number of short upright 1-inch tubes were screwed into a hollow cast-iron base or box; and were either connected together in pairs by return-bends at the top, or else each tube stood singly with its top closed, and had a hoop-iron partition extending up inside it to nearly the top. For getting rid of the air, a trap was provided, having an outlet controlled by metallic rods; as soon as all the air had escaped and the rods became heated by the unmixed steam, their expansion closed the outlet. For indirect radiating surfaces, the box-coils were the forms most used. The chambers containing them were made either of brickwork, or often of galvanized sheet-iron; the coils were suspended freely within the chambers, which were themselves attached to the walls containing the air inlet flues.

Where systematic ventilation was carried out in conjunction with warming, these indirect radiators and chambers were employed. The warming could be most effectually controlled by so arranging the chamber containing the radiator, that the whole or any part of the fresh air entering could be made either to pass through the radiator and be warmed, or to "by-pass" it and escape heating. The warmed and unwarmed currents were then mingled in a flue, whence a supply of fresh air suitably tempered flowed into the room, the occupant of which could thus regulate the temperature as comfort might require, while obtaining a constant supply of a definite quantity of fresh air.

Where a blowing-fan was employed for impelling a current of air through a building, a large auxiliary coil, placed at the entrance of the flue leading from the fan into the building, would be an improvement for extensive apparatus, and would save about 10 per cent. of surface, while supplying a constant volume of fresh air raised to any temperature between 50° and 120°.

An example of warming on an extensive scale was afforded by a large office-building in New York, containing nearly 2,000,000 cubic feet; and by the State Lunatic Asylum at Indianapolis, containing more than 2,500,000 cubic feet. Both of these buildings were heated by steam. But such instances failed to convey any idea of the very general prevalence of warming by steam in the commercial cities of America. There appeared indeed no limit to the future extension of systematic steam supply for warming and for motive power.

An Appendix enumerated the commonly accepted data which formed the basis for computing the efficiency of the warming surfaces, the size of the mains, and the proportions of the various details; and Tables were given of the formulæ and figures most generally useful for working out the practical dimensions suited to any particular application.

Water boilers are usually fitted with rings in their ends for the attachment of pipes. Mr. John Trageser has patented a device by which they are attached in a quick and inexpensive manner. The aperture in the boiler is made slightly elliptic in form, and the ring fits closely across the shortest diameter. The ring is heated and placed in the aperture into which it is swaged to fill the aperture by means of a suitable mandrel and die. The shape of the aperture prevents the ring from turning in cutting the thread.

A new switch for grounding telephone or telegraph lines has been patented by Messrs. Benjamin McCabe, Charles R. Swain, and James T. Sutton, of Peekskill, N.Y. The object of this invention is to prevent telephone and telegraph instruments from being injured by electricity discharged from the clouds during thunder storms. It is constructed with a series of conductors and springs connected with the ground wire, a series of conductors and springs connected with the instrument wires, and a series of conductors attached to a sliding bar and connected with the line wires, so that the line wires can be connected with the ground wire or the instrument wires by a single movement.

Messrs. Robert and Sidney T. Bruce, of Marshall, Mo., have patented a *corn planter* in which the seed dropping device is operated by a toothed metallic disk that is made to rotate through the ploughed soil in contact with the hard ground underneath, avoiding the irregularity of the operation which results from driving in contact with the uneven surface of the soil. The dropping slide is operated by a crank shaft and pitman, driven by a pinion on the side of the disk.

A machine for bending *wooden stirrups* has been patented by Mr. John B. Chiles, of Kernstown, Va. A former-block, over which the stirrup is to be bent, is provided, and the steamed block is pressed against the bottom of the former by a foot lever. By suitable devices operated by a crank shaft the block is pressed around the former-block to fit it, and it is secured by a clamp to retain it in shape, when it is removed to make place for another block.

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